Patent Claims

1. Device for welding a joining contour by laser radiation, with a laser diode (1), a light-conducting fiber (2) which is arranged in front with reference to the radiating direction of the laser diode (1), the beam bundle emitted by the laser diode (1) being coupled into the entrance surface of the light-conducting fiber (2) and the exit surface (3) of the light-conducting fiber (2) being arranged in front of a beam-shaping optical unit with reference to the direction of radiation so that the beam bundle images a focal spot, via the beam-shaping optical unit, on a workpiece surface (5) arranged downstream of the beam-shaping optical unit, characterized in that the beam-shaping optical unit comprises at least one gradient index lens (4.1, 4.2) which is connected to at least one linear movement unit by means of which the gradient index lens (4.1, 4.2) is deflected radial to the exit surface (3) by a displacement path in order to generate a deflection of the beam bundle so that the focal spot scans a joining contour on the workpiece surface (5).

2. Device according to claim 1, characterized in that the beam-shaping optical unit comprises exactly one (the first) gradient index lens (4.1) which is connected to two linear movement units provided by a first and a second piezo actuator 6.1, 6.2 which cause a deflection of the first gradient index lens (4.1) in directions perpendicular to one another.

3. Device according to claim 1, characterized in that the beam-shaping optical unit comprises exactly two gradient index lenses (4.1, 4.2) which are arranged one behind the other with reference to the direction of radiation and which are connected, respectively, to a linear movement unit provided by a first and a second piezo actuator 6.1, 6.2 in order to deflect in directions perpendicular to one another with respect to the exit surface (3).

4. Device according to one of claims 1 to 3, characterized in that the beam-shaping optical unit is constructed in such a way that the exit surface (3) is arranged at a distance of less than 0.3 mm in front of the first optical surface and the workpiece surface (5) is arranged at a distance of greater than 10 mm behind the final optical surface of the beam-shaping optical unit, and the beam-shaping optical unit has an imaging scale of greater than 30.

5. Device according to claim 2, characterized in that the beam-shaping optical unit is constructed in such a way that the exit surface (3) lies in its object plane and the workpiece surface (5) lies in the image plane in the undeflected state, and the beam-shaping unit has a depth of focus range that is greater than a maximum change in distance of a non-plane workpiece surface (5) over the range of deflection relative to the final optical surface of the beam-shaping optical unit (4).

6. Device according to claim 2, characterized in that the first piezo actuator (6.1) and the second piezo actuator (6.2) are connected to the first gradient index lens (4.1) directly by an arm (10) which translates the actuating path of the piezo actuators (6.1, 6.2) into the displacement paths of the first gradient index lens (4.1).

7. Device according to claim 6, characterized in that the piezo actuators (6.1, 6.2) are fixedly attached, respectively, by one end to a base plate (13) and contact a bearing plate (12) of the arm (10), respectively, by their free end, and the bearing plate (12) is swivelable around a pivot point that is fixed with respect to the base plate (13) so that when the piezo actuators (6.1, 6.2) are activated the bearing plate (12) and, therefore, the arm (10) are swiveled around the pivot point corresponding to their actuating paths.

8. Device according to claim 7, characterized in that the pivot point is defined by a pivot joint which is located at one end of a third piezo actuator (6.3) that determines the distance of the pivot point from the base plate (13) parallel to the piezo actuators (6.1, 6.2).

9. Device for welding a joining contour by laser radiation, characterized in that it comprises a plurality of devices according to one of claims 1 to 8 which are arranged relative to one another in such a way that the respective scanned joining contours correspond to partial joining contours which combine to form a larger closed joining contour without overlapping of the partial joining contours.